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1934

## Geometry and Mechanics (2nd Year): Technical School Examinations 1934

Department of Education: Technical Instruction Branch

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# COURSE IN BUILDING.

(33)

## AN ROINN OIDEACHAIS.

(Department of Education.)

## BRAINSE AN CHEARD-OIDEACHAIS.

(Technical Instruction Branch.)

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### TECHNICAL SCHOOL EXAMINATIONS.

1934.

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### GEOMETRY AND MECHANICS.

(Second Year.)

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*Thursday, May 24th—7 to 10 p.m.*

*Examiner—F. W. WARWICK, ESQ., B.A., B.E., A.R.C.SC.I.*

*Co-Examiner—J. P. HACKETT, ESQ., B.E., A.R.C.SC.I.*

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#### GENERAL INSTRUCTIONS.

You are carefully to enter on the Answer Book and Envelope supplied your Examination Number and the subject of examination, but you are not to write your name on either. No credit will be given for any Answer Book upon which your name is written, or upon which your Examination Number is not written.

You must not have with you any book, notes or scribbling-paper, except the book of logarithms supplied to you.

You are not allowed to write or make any marks upon your paper of questions.

You must not, under any circumstances whatever, speak to or communicate with another candidate; and no explanation of the subject of the examination may be asked for or given.

You must remain seated until your Answer Book has been taken up, and then leave the examination-room quietly. You will not be permitted to leave before the expiration of twenty minutes from the beginning of the examination, and will not be re-admitted after having once left the room.

If you break any of these rules, or use any unfair means, you are liable to be dismissed from the examination, and your examination may be cancelled by the Department.

*Three hours are allowed for this paper. Answer Books, unless previously given up, will be collected at 10 p.m.*

## INSTRUCTIONS.

*Read the General Instructions on page 1.*

(a) The working of the questions and the answers must be in *ink*.

(b) Diagrams and drawings must be made in *pencil*.

(c) Full credit cannot be obtained for any question unless all the calculations are shown clearly, and construction-lines definitely indicated.

Where calculations are made with the aid of the slide-rule, a note should be made in the margin thus—(S.R.).

(d) Not more than *seven* questions in all may be attempted, of which not more than *four* may be taken from either Section. Equal values are assigned to the questions.

(e) Write the number of the question before the answer.

NOTE.—You are expected to make neat and correct diagrams. Books of logarithmic and trigonometrical tables (four places) are provided. You may use a slide-rule and drawing instruments.

## SECTION I.

*(Not more than four of the seven questions you may attempt may be taken from this section).*

1. A plot of ground ABCDE (Fig. 1) is bounded by three straight and one irregular fence. The lengths of the straight fences are AB=340 links, BC=130 links, EA=140 links, and diagonal AC=340 links. To fix the outline of the fence CDE perpendicular distances are measured to the fence from the line CE at distances from C as follows:—

Distance from C (links) ..	0	50	100	150	200	260
Perpendiculars (links) ..	0	25	37	35	20	0

Draw a plan of this plot of ground to a scale of 1 inch=100 links.

2. The depth of a drain 60 yards long was measured at intervals of 10 yards with the following result:—

Distance from one end (yds.) ..	0	10	20	30	40	50	60
Depth (feet) ..	5.0	4.0	3.5	3.7	4.4	5.2	5.8



From the measurements given in the table find the area of the longitudinal section of the excavation in square yards, and, assuming the trench to be 2 ft. 6 ins. wide, find the volume of material excavated.

3. Draw the moulding to the dimensions shown on the sketch (Fig. 3).

The scotia PXQ is a semi-ellipse and PQ and CX lie on conjugate axes. C is the mid point of PQ, and CX drawn parallel to QT is one inch long.

4. The projections of a hood are shown at Figure 4. Find the traces of the three slant planes A, B and C. Find also the true shape of these surfaces.

5. Figure 5 gives to scale a plan and an end elevation of a stone cap.

Draw a side elevation to the same scale.

6. The projections of a jib AB and two ties AC and AD are given at Figure 6.

Find the true lengths of the jib and ties and the value of the angle BAC.

7. The projections of a cylindrical tower with conical roof are shown at Figure 7. Obtain the shape of the section made by the vertical plane whose horizontal trace  $ht$  is parallel to  $xy$ .

## SECTION II.

*(Not more than four of the seven questions you may attempt may be taken from this section.)*

8. Find the reactions at the supports A and B of the truss, whose form is given at Figure 8, due to loads of 3 and 2 tons acting at the points indicated. Find also the nature and magnitude of the force in each member of the truss.

9. A single purchase winch with a drum of 10 inches effective diameter has a gear wheel, mating with a pinion, fixed on the same axis. The gear has four times as many teeth as the pinion. A crank handle, of radius 15 inches, is fixed to the pinion axis.

What is the velocity ratio of the machine? If the efficiency of the machine is 70% what effort is required to raise 2 cwt.?

10. Define "Work," "Power," "Horsepower." A lorry weighing 2 tons travels at a uniform speed of 30 miles per hour up a hill rising 1 in 60 (*i.e.* the tangent of the angle of slope is  $\frac{1}{60}$ ).

If the frictional resistance to motion is 60 lb., what horsepower is required?

11. How does the force of friction depend on—

- (a) the pressure between the surfaces in contact,
- (b) the area of the surfaces in contact,
- (c) the relative velocity between the surfaces?

The coefficient of friction between bricks and wood is 0.4. At what angle of slope should a timber shoot be set so that bricks will slide down it with uniform speed?

12. Find the position of the centre of gravity of the section of a retaining wall whose dimensions are shown at Figure 12.

If the material of the wall weighs 120 lb. per cubic foot, what horizontal force,  $P$  per foot run, applied at a height of 5 feet above the base, will just cause the wall to overturn about  $A$ ?

13. A steel tie rod in a truss is  $\frac{3}{4}$  inch diameter and 12 feet long when unloaded. If its modulus of elasticity is  $30 \times 10^6$  lb. per square inch, what length will it be when it carries a tensile force of 4 tons.

Give the answer in inches correct to three decimal places.

14. A portion of a roof truss shown to scale at AQP carries a vertical load of 2 tons at each of the joints  $B$  and  $Q$ ; there is also a vertical reaction of 3 tons at the support  $A$ .

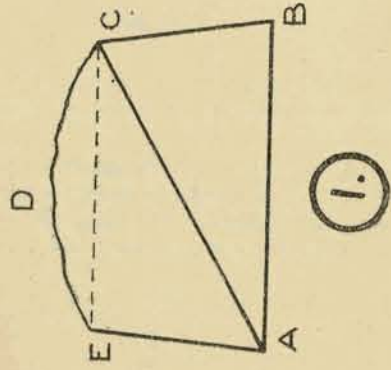
This portion of the truss is kept in equilibrium by two forces whose lines of action are  $PS$  and  $QT$ .

By taking moments about  $Q$  find the direction and magnitude of the force at  $P$  and by taking moments about  $P$ , find the direction and magnitude of the force at  $Q$ .

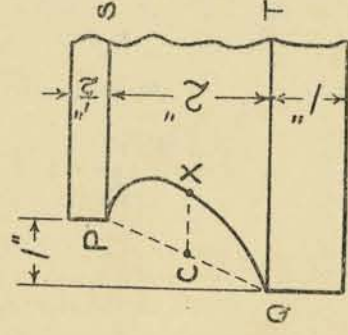


# Geometry & Mechanics (Second Year).

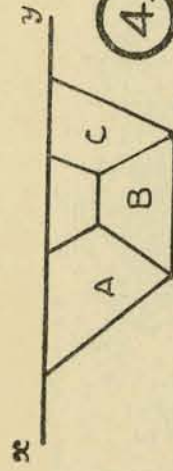
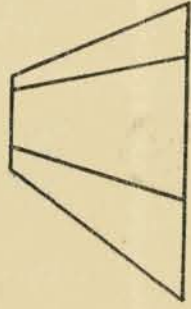
Note:—The diagrams are numbered to correspond with the questions to which they refer.



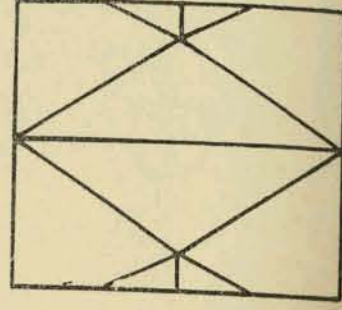
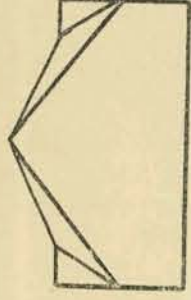
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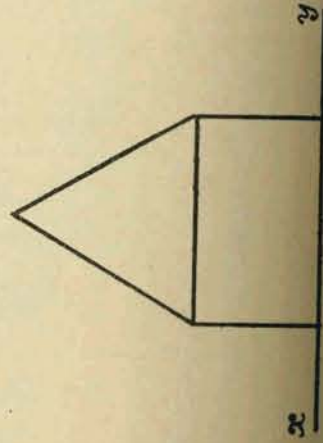
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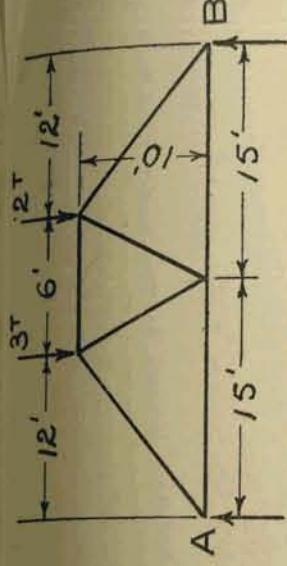
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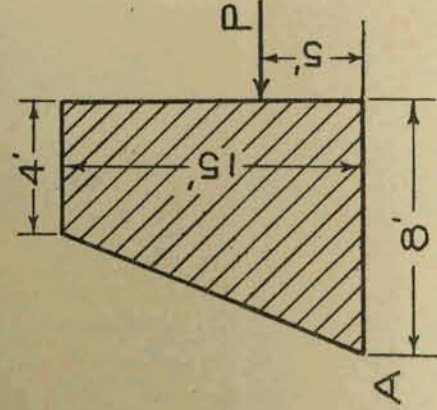
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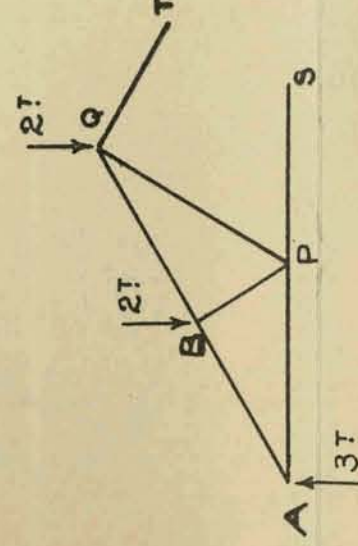
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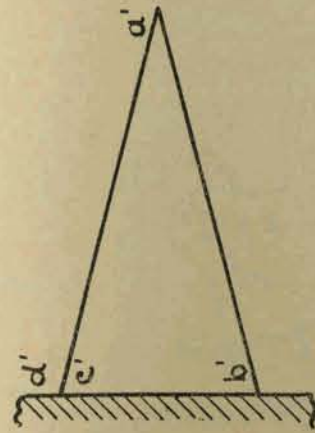
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(12.)



(14.)



(6.)

